

Serial No.: 10/736,946

Reply to Office action of August 24, 2005

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Listing of the Claims

Claims 1. - 22. (cancelled)

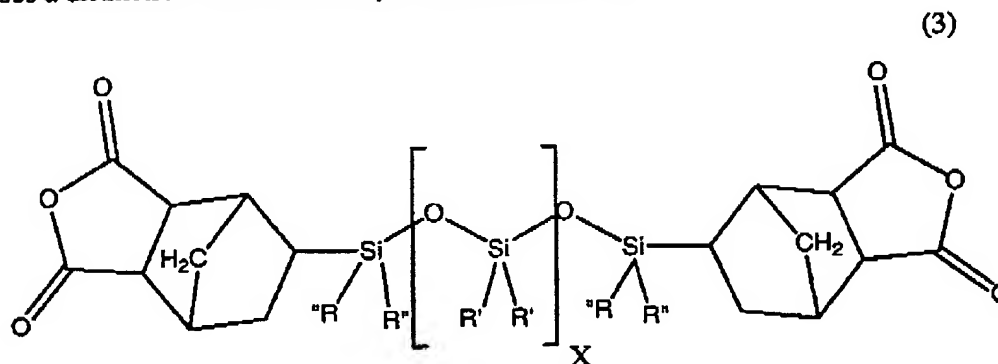
Claim 23. (Currently amended) An underfill composition comprising:

a first curable transparent resin composition comprising an aromatic epoxy resin in combination with a solvent, a functionalized colloidal silica dispersion, and at least one other component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin,

wherein the second curable fluxing composition further comprises at least one epoxy hardener, and

~~The underfill composition of claim 21,~~ wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride of the formula:



where X is from 0 to 50 inclusive, and each R' and R'' are independently selected from the group consisting of C₁₋₂₂ alkyl, C₁₋₂₂ alkoxy, C₂₋₂₂ alkenyl, C₆₋₁₄ aryl, C₆₋₂₂ alkyl-substituted aryl, and C₆₋₂₂ arylalkyl.

Claim 24. (Original) The underfill composition of claim 23, wherein the at least one difunctional siloxane anhydride comprises a mixture of oligomers of formula (3) and wherein X in formula (3) is from 0 to 10 inclusive.

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Claim 25. (Original) The underfill composition of claim 23, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

Claim 26. (Original) The underfill composition of claim 23, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

Claims 27. – 34. (Cancelled)

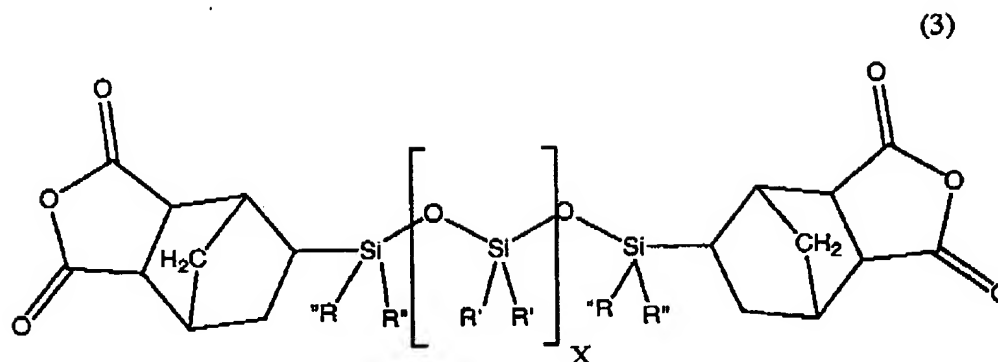
Claim 35. (Currently amended) An underfill composition comprising a first curable transparent resin composition comprising at least one aromatic epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds, and combinations and mixtures thereof; and a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener.

~~The underfill composition of claim 29,~~ wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride of the formula:

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where X is from 0 to 50 inclusive, and each R' and R'' are independently selected from the group consisting of C₁₋₂₂ alkyl, C₁₋₂₂ alkoxy, C₂₋₂₂ alkenyl, C₆₋₁₄ aryl, C₆₋₂₂ alkyl-substituted aryl, and C₆₋₂₂ arylalkyl.

Claim 36. (Original) The underfill composition of claim 35, wherein the at least one difunctional siloxane anhydride comprises a mixture of oligomers of formula (3) and wherein X in formula (3) is from 0 to 10 inclusive.

Claim 37. (Original) The underfill composition of claim 35, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

Claim 38. (Original) The underfill composition of claim 35, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

Claim 39. (Cancelled)

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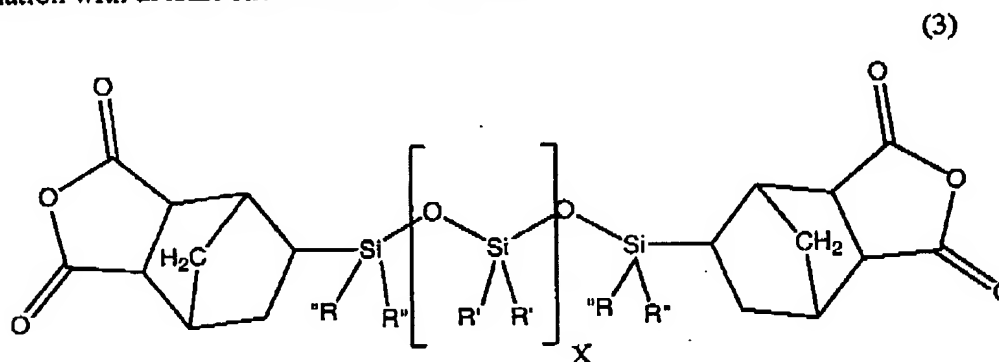
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Claim 40. (Original) An underfill composition comprising

a first curable transparent epoxy resin comprising a cresol novolac epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds, and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin in combination with at least one difunctional siloxane anhydride epoxy hardener of the formula:



where X is from 0 to 50 inclusive, and each R' and R'' are independently selected from the group consisting of C₁₋₂₂ alkyl, C₁₋₂₂ alkoxy, C₂₋₂₂ alkenyl, C₆₋₁₄ aryl, C₆₋₂₂ alkyl-substituted aryl, and C₆₋₂₂ arylalkyl.

Claim 41. (Cancelled)

Claim 42. (Amended) A solid state device comprising:

a chip;

a substrate; and

an underfill composition between the chip and the substrate comprising a first curable transparent resin composition comprising at least one aromatic epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group

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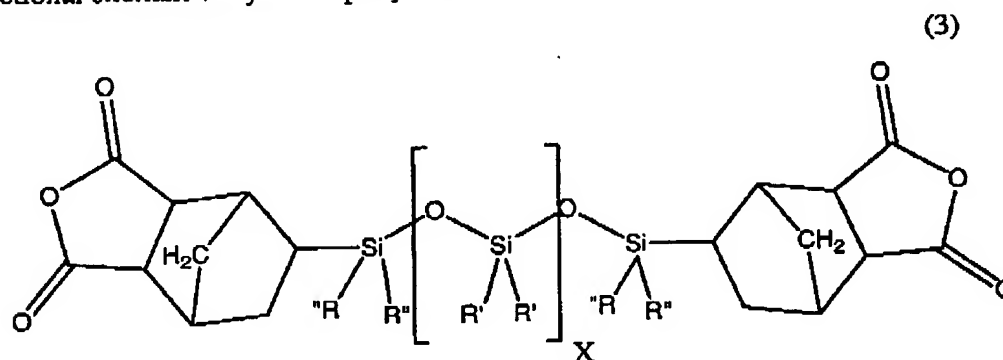
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consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener.

The solid state device of claim 41, wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride epoxy hardener of the formula:



where X is from 0 to 50 inclusive, and each R' and R'' are independently selected from the group consisting of C₁₋₂₂ alkyl, C₁₋₂₂ alkoxy, C₂₋₂₂ alkenyl, C₆₋₁₄ aryl, C₆₋₂₂ alkyl-substituted aryl, and C₆₋₂₂ arylalkyl.

Claim 43. (Original) The solid state device of claim 42, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

Claim 44. (Original) The solid state device of claim 42, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

Claim 45. (Cancelled)

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Claim 46. (Original) A method for producing a solid state device comprising:

applying to a chip a first curable transparent resin composition comprising an aromatic epoxy resin in combination with a solvent, a functionalized colloidal silica dispersion, and at least one other component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof, to produce a coated chip;

applying a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener to a substrate;

placing the coated chip on a portion of the substrate to which the fluxing composition has been applied; and

curing the first curable transparent resin composition and second curable fluxing composition to form an underfill composition.

Claim 47. (Original) The method of claim 46 wherein the step of applying the first curable transparent resin composition further comprises applying a first curable transparent resin having colloidal silica possessing a particle size of between about 20 nm and about 100 nm.

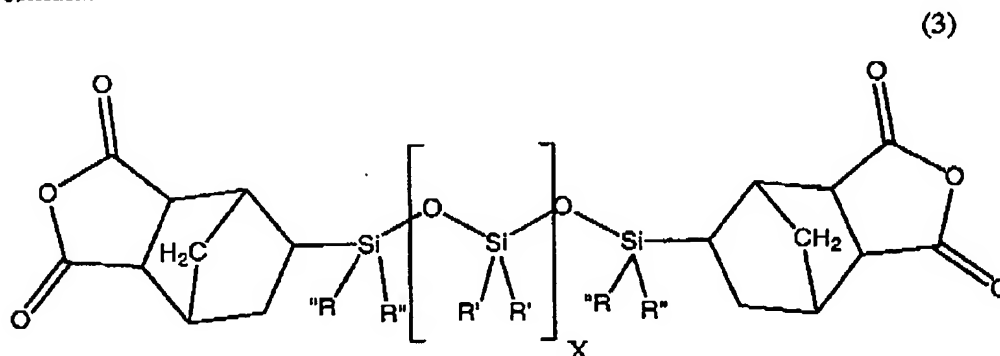
Claim 48. (Original) The method of claim 46 wherein the step of applying the first curable transparent resin composition further comprises removing the solvent to form a hard, transparent B-stage resin film on the chip.

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Claim 49. (Original) The method of claim 46 wherein the step of applying the second curable fluxing composition to the substrate further comprises applying an epoxy resin in combination with at least one epoxy hardener comprising a difunctional siloxane anhydride of the formula:



where X is from 0 to 50 inclusive, and each R' and R'' are independently selected from the group consisting of C₁₋₂₂ alkyl, C₁₋₂₂ alkoxy, C₂₋₂₂ alkenyl, C₆₋₁₄ aryl, C₆₋₂₂ alkyl-substituted aryl, and C₆₋₂₂ arylalkyl.

Claim 50. (Original) The method of claim 46 wherein the step of applying the second curable fluxing composition to the substrate comprises applying a second curable fluxing composition which further comprises a colloidal silica dispersion functionalized with at least one organoalkoxysilane and having a particle size of between about 5 nm and about 200 nm.